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ABSTRACT

An online library system is an example of a complex computer system in that it supports a variety of users, both patrons and staff, and is made up of many intricate programs with complex relationships among them. Certain features are essential to a user friendly system: (1) users cannot get lost in the system; (2) users cannot enter illegal commands; (3) users can choose among several simple modes of data entry; and (4) users are in control. These characteristics are exemplified by the Northwestern Online Total Information System (NOTIS), which is being installed at the University of Pennsylvania to form the heart of PennLIN, Penn's Library Information Network. Due to the complexity and multiplicity of functions of online catalogs, it has proven difficult to develop user interfaces that are adequate. Very little research has been done on the best format and content of screen displays. Preliminary findings indicate that graphic design and layout of displays are extremely important, but very few studies have focused on library applications. Opinion also varies on the use of color to enhance displays, and no definitive research results are known that support the superiority of color or monochrome displays for patron or staff use. Some conclusions based on observation and experience and questions that need research are presented, and it is concluded that although user interfaces have improved a great deal since the earliest attempts to design user-friendly systems, there is still a long way to go before online systems are truly user friendly. (MES)

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You've Come A Long Way Baby, But...

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As computer systems moved out of the laboratory, it became apparent that many of them were intended to be used by people who had no knowledge of programming or understanding of systems. It soon became necessary to develop more congenial ways for people to interact with systems and the whole notion of the "computer-user interface" or the "man-machine dialogue" was born.

In general, the complexity of a computer system can be categorized as shown in Figure 1. This figure illustrates how systems complexity increases depending on the number of programs or modules it contains and who will use it. The simplest case, of course is a single program written by one person for his or her own use. System complexity is increased by two major factors: 1) If the system includes more than one program which must work together, and 2) if the system is to be used by someone other than the programmer who wrote it. Obviously, programmers can get away with leaving an error message that says something cryptic like "ZERO-LENGTH RESPONSE NOT ALLOWED" or worse, but if a computer system is to be used by others, the instructions for using the system and any error messages that may be necessary must be clear to the user.

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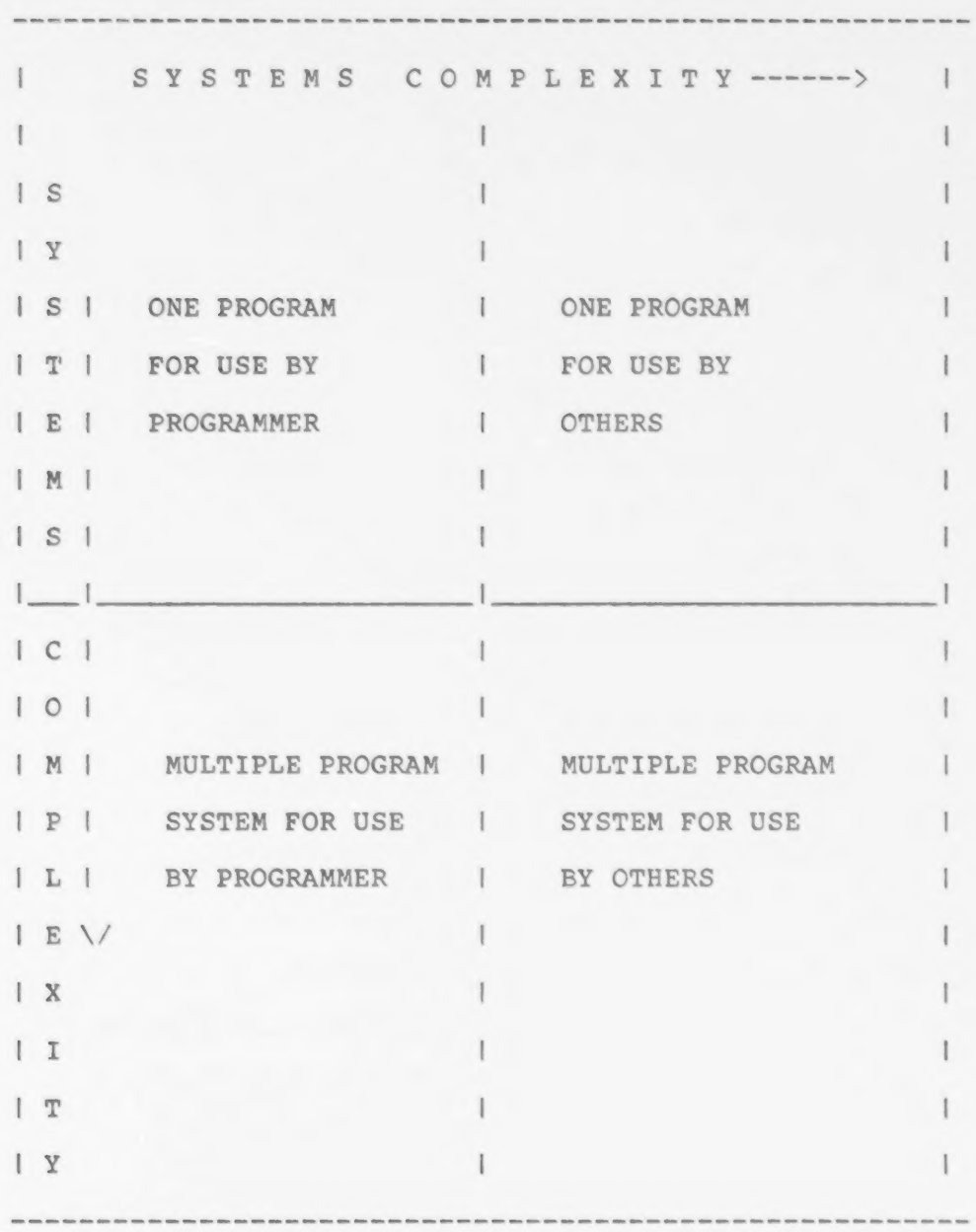
SYSTEMS COMPLEXITY ------>
SYSTEMS COMPLEXITY
ONE PROGRAM FOR USE BY PROGRAMMER
ONE PROGRAM FOR USE BY OTHERS
MULTIPLE PROGRAM SYSTEM FOR USE BY PROGRAMMER
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Figure 1: How Computer Systems Become Complex

Online library systems are a classic example of complex systems of programs designed for use by others. Library systems are made up of many intricate programs with complex relations among them. The library database consists of numerous files which are inter-related in various ways. Library users--both staff and patrons--need to perform a large number of complex actions using these programs and files. The challenge to the library systems designer is to create an effective user interface for this environment.

Early attempts at developing effective interfaces assumed that it was a relatively trivial matter to design a few menus and other screen displays to guide the user through the system and provide assistance when needed. Many bad experiences have now shown that designing effective user interfaces is neither simple nor easy. The process of developing a new user interface may appear to be simple because the best interfaces are simple and easy to the use. But this very simplicity is deceptive. It usually means that under the surface, some very sophisticated language parsers, menu displays, and command syntax structures are in place that effectively hide all the system's complexities from the user.

Another difficulty facing designers of user interfaces is that they are usually in the position of creating a so-called "user-friendly front end" or interface to an existing system. Although cleverly constructed menus and screen displays can help to make a system more user-friendly, some of the problems that arise may be caused by a poorly designed underlying system. These difficulties may be almost insurmountable. For example, some online systems use a derived search key (e.g. first four letters of the author's name followed by a commma, followed by the first three characters of the first significant word of the title). Explaining how to construct this search key to the novice user in a friendly fashion is virtually impossible. The best solution may be to develop a parser that analyzes the user's search request and constructs the search key. This approach may not be entirely satisfactory because the search results produced by the derived key may not be at all what the user wanted.

Perhaps in the future some new library systems designer will think about how users ought to be able to get information out of an online library system and then will create a system to support it. Apple took this approach with the Macintosh personal computer. Computer designers at Apple had many new ideas about how users ought to be able to work with a personal computer and they then set about developing a machine to allow these new approaches. Cambridge Library System's original touch-screen interface to the library

online catalog was an early attempt to provide such a new mode of access. As is well known now, this effort was partially successful. It was well-liked by users in small libraries but found to be too slow and too cumbersome by patrons in large libraries. Nevertheless, it was a brave attempt at finding an entirely new approach to online library catalog access. Similarly innovative efforts must be encouraged in the future.

FEATURES OF A USER-FRIENDLY SYSTEM

A user-friendly system has a few well-known characteristics. These may be implemented in quite different ways, but the results as far as the user is concerned will be quite similar. The main features are:

- Users cannot get "lost" in the system.

  The system always lets the user know what is being done and offers suggestions about what to do next. There are no surprises. The system does not, at the touch of a finger, go off and perform some action that is totally incomprehensible to the user.

- Users cannot enter illegal commands.

  The system prompts for certain user actions. If the anticipated choice is not made, the system does nothing or

prompts again for the expected data, perhaps at the same time suggesting an appropriate choice.

- Users can choose among several different simple modes of data entry.

  One keystroke or perhaps pressing the ENTER key is all that is required of the user. Some systems that are equipped with a mouse or other pointing device allow users to enter data using the device or using the keyboard.

- Users are in control.

  The user is given enough information about the system to understand how it works and how to make it do what the user wants. The user has a mental model of the system.

USER INTERFACES FOR LIBRARY APPLICATIONS

Online library systems need good user interfaces to be successful. Although the basic concepts of online information retrieval are relatively simple, the features of many online catalog systems are not simple. Further, the library card catalog itself is not simple or easy to use. Thus, an effective user interface for an online library system has to deal with complex record structures, data types, and files and it must be a comfortable tool for the

occasional library user as well as the experienced staff member. This is asking a lot. The specifications for most library user interfaces have a built-in multiplicity of functions that is seldom questioned. For example:

- Is the user interface intended to teach users how to use the online catalog or how to use the library or both?

- Is the user interface intended for use by library patrons or staff or both?

- Is the user interface intended to make the system easy to use or easy to learn or both?

- Is the user interface intended to serve the infrequent or casual user, the expert user, or both?

If the answer is "all of the above" it is no wonder that it has proven difficult to develop user interfaces for online library systems that are adequate.

MODIFICATIONS TO THE NOTIS SCREEN DISPLAYS FOR PENNLIN

The Northwestern Online Total Information System (NOTIS) software is being installed at the University of Pennsylvania to form the heart of PennLIN, Penn's Library Information

Network. As part of this process, the NOTIS screen displays are being modified to suit the Penn environment.

NOTIS is a command-driven system; that is, the underlying design philosophy in constructing the system is that users should be able to enter any command for which they are authorized at any point in the session. Therefore in NOTIS, the screen displays that have been developed for LUIS, Northwestern's Library User Information System, are really prompts for commands rather than true menus. One of the difficulties that arises is how to present all possible options to users without overwhelming them with choices. Another problem is how to move from the command prompt screens to help screens and back without confusing users. Figure 2 shows the NOTIS screen displays and the linkages between them.

Although the choice of wording on the screen displays is very important in creating a user friendly system, having an underlying strucutre for the screens and menus that is clear to the user is even more important. It is this structure that serves to:

- Keep users from getting "lost" in the system
- Keep users in control
- Give users a mental model of the system

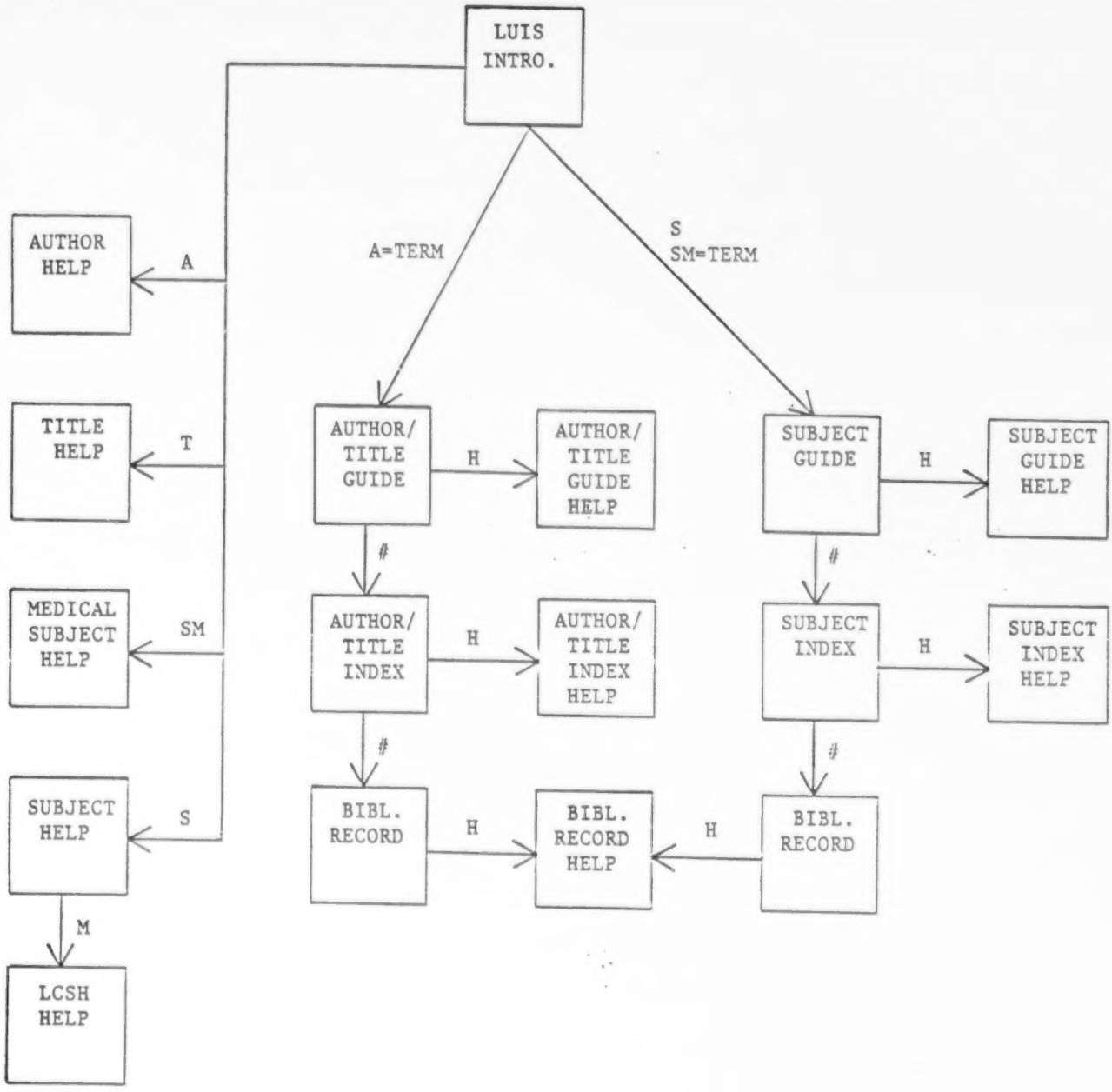

Figure 2: NOTIS/LUIS SCREEN DISPLAYS

In a recent article (1), Ben Schneiderman has stated that "the primary task for menu designers is to create a sensible, comprehensible, memorable, and schematic organization." He likens this organization to a breakdown of a larger whole into its parts such as the chapters in a book, a catalog into sections, or a restaurant menu into categories such as appetizers, soups, and desserts. Dr. Schneiderman further categorizes menu systems into two main classes: 1) Single-menu systems; that is, a system with one menu offering binary or multiple choices. 2) Sequences of menus. These may be linear, tree-structured, or cyclic or acyclic networks. Simple menu systems cause few difficulties for users because they offer limited options, but more complex menu structures require that users understand how to move around the system; that is, how to navigate the sequences of menus.

Very little research work has been done on the best format and content of screen displays. Empirical findings have led to some conclusions, but much more work needs to be done. Preliminary findings indicate that graphic design and layout of the displays are extremely important, but there are almost no research studies that have focussed on library applications. Opinion varies on the use of color to enhance patron or staff displays, but no definitive research results are known which support the superiority of color or monochrome displays for patron or staff use.

Some conclusions gathered from observation and experience are:

- Don't use jargon.
- Especially don't use computer jargon.
- Use familiar and consistent terminology.
- Use consistent and concise phrasing.
- Make screens consistent in format and terminology from frame to frame.
- Use the same area of the screen to display prompts or for user data entry from screen to screen.
- Don't make the screens too full.
- Don't overwhelm the user with choices; 5 to 7 options is optimal.
- Make sure that menu choices are clear and do not overlap.
- Try to eliminate error messages. Users should not be able to do anything "wrong".
- Give users a hint about the result of menu choices; that

is, there should be no surprises.

- Use letters or numbers for menu choices, but not both.

- Letters are preferred for menu choices because of their mnemonic value, but letters must be selected with care.

- Put the most important part of the instruction at the beginning of the line.

- Keep the user in control. Have an "undo" key if possible.

- Keep it simple, remembering that what seems simple to the user may mean that very sophisticated processing is taking place in the background.

RESEARCH TOPICS FOR DEVELOPING USER FRIENDLY SYSTEMS

As indicated above, there are many topics in the design of user interfaces that are poorly understood. There is a great opportunity for testing the online library systems now in use to see what works and, conversely, what does not and to test new ways of handling various interface peoblems. Some unanswered questions that need research follow:

- When specifying a menu choice, should the action precede or follow the explanation in the display; e.g.

Type A To search for an author

or

To search for an author Type A

- What area of the screen display should be reserved for user data entry?

- What is the best place on the screen to use for error messages (if any)?

- Highlighting seems to be effective if not over-used. How is it best employed?

- What about color displays? Is color just a frill? Does it have any use besides its value as a novelty?

- What indicators on the screen (e.g. leader dots, dashes, arrows, blank space) work best to connect menu choices with the appropriate actions?

- How is white space best used?

- What is the best way to handle a menu or screen display that is too big to fit on one screen?

Specifically for the library online catalog, a few other areas in which research results would be extremely useful:

- In what order should bibliographic records appear? Should it be the same for staff and for public users?

  Some online library systems display bibliographic citations in conventional author-title order while others display the most recent additions to the file first. What order is preferred? Should users have a choice? Should users learn how to do online sorting of records?

- What fields or data should appear for each bibliographic record? Should there be a default which users may change?

  Research has shown that patrons use very little of the information that is available on the conventional library catalog card. Are all of the data elements necessary? Which ones should users see? Should users be able to select different levels of completeness?

- What techniques work best to help users whose search strategy nets too few results or too many?

  Preliminary analysis of online catalog transaction logs show that users whose search strategies retrieve too many or too few citations have difficulty in narrowing or

broadening the search. Is this a fault of the system? Is it because users don't understand retrieval of sets? A related issue is how much information is enough information and what is the library's responsibility to make sure users get all available information whether they want it or not?

- How can one determine if a search that results in no hits represents a failure of the system or a failure of the database?

  Several studies have shown that searches of online catalogs sometimes do not retrieve the desired records when the records are, in fact, in the database. Sometimes it is difficult to determine if this is the fault of the system or the fault of the search strategy. In other cases, the desired records really are not in the database. What tests can be made to increase confidence in the retrieval effectiveness of online systems?

- What is the best way to explain the basic idea of retrieval of sets to library users?

  Analysis of online catalog transaction logs and user comments reveal that some patrons and staff members really do not understand the concept of retrieval of sets of citations from an online database. Some of these same users have had a formal introduction to set theory, but

apparently there is no carry-over to the library application. How can the interface give these users a good mental model of the online database so that they will truly understand how the system works? Should online catalogs emulate the card catalog? Are there other models that are more appropriate?

CONCLUSION

User interfaces have come a long way since the earliest attempts to design user-friendly systems. Few of today's systems resort to the withering "Illegal command" or other decidedly unfriendly responses. Most of the new systems are no longer user-hostile or user-vindictive, although some are still rather opaque and require that users learn more about the system than most of them ever wanted to know. Still, thousands of happy users use hundreds of these systems every day, but...there is still a long, long way to go before online systems are truly user-friendly.

In the future, advances in artificial intelligence and expert systems may offer a path to creating user interfaces that are more natural; that is, they will allow queries to be posed in natural language and help users to select the most appropriate sources for searching. But in the near term, if systems designers applied the empirical results gleaned from online catalog use and other studies

that are available already, online systems would improve. More information about how users would like systems to operate and a much better understanding of the fine art of designing screens and constructing menus will help to make online systems much more acceptable to users. Perhaps that is what we really mean by user-friendly.

Schneiderman, Ben. "Designing Menu Selection Systems", in Journal of the American Society for Information Science, 37(2):57-70; 1986.